Effect of Concurrent Training on Metabolic Biomarkers Among Sedentary Women

SHORT SYNOPSIS

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Certificate

I hereby declare that the short synopsis "**Effect of Concurrent Training on Metabolic Biomarkers Among Sedentary Women**" being submitted in partial fulfilment of the requirement for the degree of Doctor of Philosophy in Physical Education under Department of Exercise Physiology of Lakshmibai National Institute of Physical Education, Gwalior, during the academic year 2022

It is a Bonafide record of original work carried out under the supervision of Dr. Deepak Sharma and has not been submitted in full or part to any other university or institute for a degree or diploma. Further, it is certified that the short synopsis is plagiarism-free, and the proof has been submitted.

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Abstract

Metabolic syndrome is a combination of multiple conditions such as hypertension, hypercholesterolemia, insulin resistance and obesity which lead to various chronic diseases such as cardiovascular diseases, diabetes mellitus and these all are the major health problems in present scenario. The major possible root causes of metabolic syndrome are sedentary lifestyle and poor diet, which can prevent exercise can be prevented through some little change in lifestyle. Exercise is medicine. Exercise can play a very big role in preventing and dealing with metabolic health problems. But exercise protocol is very important here, to optimize the benefits of the right type of exercise at right load in proper way be follow. So, to understand the effect of combine aerobic and resistance training i.e. concurrent training on metabolic health, This study delas with the research problem "Effect of Concurrent Training on Metabolic Biomarkers Among Sedentary Women''. For this study researcher selected the sedentary females and they further assigned to three different group: two experimental group based on age (Group I – age range of 25-35 years and Group-II 36- 45 years) and third group is Control Group. To execute this study Pretest-Posttest research design will be used. Before and after 8 weeks of study the assessment of this selected biomarker: Low density lipoprotein (LDL), High density lipoprotein (HDL), Triglyceride (Tg), Total cholesterol (TC), fasting insulin level (FIL), Insulin resistance (IR) , Systolic Blood Pressure (SBP), Diastolic Blood pressure (DBP) muscle mass (MM) and fat percentage (FP) will be done. As a training intervention for experimental group 8 weeks of concurrent training will be given to both experimental group I and II and while there no instruction will be given to control group regarding exercise, they will follow their own daily regime. To analyses the Effect of Concurrent Training on Metabolic Biomarkers Among Sedentary Women descriptive statistics and ANCOA will be used. The result of this study may show the significant changes in metabolic biomarkers by following concurrent training.

Keywords- Metabolic Health, Insulin Resistance, Lipid Profile, Combined Exercise, metabolic disorders, Cardiovascular Health.

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Introduction

A sedentary lifestyle and diet are the leading cause of chronic diseases, and many health problems arise due to taking junk food and processed food. Due to modernization and advancement in technology, the mobility of human beings decreases, which results in an increase in various chronic diseases like cardiovascular disease, diabetes, cancer, and many more. This all diseases can be avoided if we take a good diet and perform physical activity, exercise is medicine it is a powerful tool to prevent and cure many of the chronic diseases. Strong data suggest that intensive lifestyle changes focused on increasing physical activity can prevent diabetes more effectively than pharmaceutical therapies. (1)

Inactivity increases fat deposition in the body and Overweight and obesity are associated with metabolic syndrome and risk of atherosclerotic cardiovascular disease. (ASCVD) (2) Metabolic syndrome is a cluster of metabolic risk factors, characterized by abdominal obesity, dyslipidemia, low levels of HDL-c, hypertension, and insulin resistance.(3) Metabolic syndrome (MS) affects approximately one-fourth of all adults (4) and is closely related to cardiovascular disease (CVD) and premature death (5) Results from 4 years of follow-up indicated that participants who increased physical activity with moderate to high intensity had 63–65% less chance of developing diabetes. (6)

Insulin is also an important factor in regulating fat metabolism (7) which will reduce lipolysis enzyme activity and HDL metabolism activity, resulting in triglyceride (TG) clearance problems. At the early stage of diabetes, the plasma insulin level is very high, which leads to the excessive synthesis of fat in the body, causing endogenous high blood TC and TG. An increase the fat and a decrease in muscle is one of the factors in developing insulin resistance. Early in the development of diabetes, the body produces an excessive amount of fat due to an extremely high plasma insulin level, which results in endogenously elevated blood TC and TG levels.

Insulin Resistance is the inability of insulin to effectively stimulate glucose uptake into metabolic tissues (skeletal muscle, adipose, and liver), turn off hepatic glucose production, and reduce adipose lipolysis, which is a primary event underlying type 2 diabetes. Insulin resistance not only contributes to hyperglycemia in type 2 diabetes but also putatively plays a role in the inappropriate excess storage of fat (ectopic) in the liver (hepatic steatosis) (8). Higher levels of ectopic storage of lipids in muscle and the liver is also associated with insulin resistance. The causality between hepatic steatosis, intramuscular lipid storage, and insulin resistance remains

controversial, but the evidence clearly shows that insulin resistance is often associated with greater ectopic fat storage. (9)

Chronic inflammation is well documented to accompany metabolic impairment in T2DM. An increase in the secretion of inflammatory adipokines including leptin and resistin along with diabetogenic pro-inflammatory cytokines from adipocytes such as tumor necrosis factor-alpha (TNF-α) and interleukin-6 (IL-6) is the fundamental characteristic of T2DM.

Exercise is proven to induce beneficial changes in glycaemic markers such as insulin resistance, HbA1C, and fasting insulin which is definitely preventive toward T2DM (1) The level of glycated hemoglobin A1c (HbA1c) seems to be a key predictor of diabetes-associated morbidity and mortality; So, a reduction in serum HbA1c by 1% results in 14% lower of myocardial infarctions and more than 20% decrease in diabetes-associated death risk. (10)

Reduction in visceral and abdominal fat is found to be the major link between exercise and insulin resistance improvement. The results of aerobic, resistance, and combined exercise on obese men showed a change in cytokine/adipokine level as well as a decrease in insulin resistance [8) A meta-analysis study comparing several trial results showed that all intensities of resistance exercises significantly reduced HbA1c.

Concurrent training (aerobic + resistance) can minimize the effects of aging on body composition and metabolism. This stems from an increase in lean mass and a reduction in body fat, in addition to increasing insulin sensitivity and energy expenditure, both during and after exercise, improving lipid metabolism. (12) The main association between exercise and improved insulin resistance is found to be a reduction in visceral and abdominal fat. Aerobic, resistance, and mixed exercise result in a reduction in cytokine/adipokine levels as well as a decrease in insulin resistance in obese males. (11) The HDL cholesterol (HDL-C) and triglyceride (TG) lipoproteins, which are typically abnormal in persons with diabetes and/or insulin resistance can be improved by exercise. (13)

STATEMENT OF THE PROBLEM

In today's world, metabolic syndrome which is a combination of hypertension, hypercholesterolemia, and cardiovascular diseases is the major problem, exercise can be a great way to prevent and reduce its symptoms. Therefore, the research problem is to investigate the "Effect of Concurrent Training on Metabolic Biomarkers among Sedentary Women"

HYPOTHESIS

After reviewing the literature and related research studies-

H_1- It has been hypothesized that concurrent training will have a significant effect on insulin resistance.

H_2 -It has been hypothesized that concurrent training will have a significant effect on resting blood pressure.

H_3 -It has been hypothesized that concurrent training will have a significant effect on fasting blood glucose levels.

H_4 -It has been hypothesized that concurrent training will have a significant effect on lipid profile.

H_5 -It has been hypothesized that concurrent training will have a significant effect on fat percentage.

H_6 -It has been hypothesized that there will be a significant association between muscle mass.

DELIMITATIONS

1. To achieve the purpose of the study, the female homemaker will be selected.

2. The study is delimited to the participants of the age groups range between 25-35 years for group I and 36-45 for group II.

3. Resistance training is further delimited to elastic band exercises and body weight exercises.

4. The dependent variable will be selected for the study to indicate the metabolic health– Insulin Resistance, Blood Glucose, Systolic, and diastolic Blood pressure, Fat percentage, Muscle Mass, and lipid profile (HDL, LDL, TG, TC).

5. The duration of the Exercise Program will be delimited to 8 weeks.

LIMITATIONS

1. The participants' dietary habits are not under the researcher's control.

2. The participants' sleeping habits and lifestyles are the study's limitations.

OPERATIONAL DEFINITION AND EXPLANATION OF THE TERMS

- **Insulin Resistance** - Insulin resistance is when cells in your muscles, fat, and liver don't respond well to insulin and can't easily take up glucose from your blood. To measure the insulin the giving formula will be used: -

  HOMA-IR = (fasting glucose x fasting insulin/405)

- **Metabolic biomarkers**- Lipid profile, insulin resistance, Blood pressure, Blood glucose level.
- **Concurrent Training** - Concurrent Training is the combination of aerobic training and resistance training.

SIGNIFICANCE OF STUDY

- This study will be the fitness instructor designing a training program regarding metabolic health.
- This study creates awareness regarding health and fitness in society.
- This study also helps to understand the women perform the exercise, especially concurrent training.
- This study helps doctors and health experts understand and know exercise's effect on various metabolic biomarkers.
- This study motivates people to adopt a healthy lifestyle.

RELATED LITERATURE

(Álvarez et al., 2017) studies the Effects and prevalence of non-responders after 12 weeks of high-intensity interval or resistance training in women with insulin resistance for this purpose Sedentary overweight/obese insulin-resistant women age = 33.5 ± 6.5 yr were selected. They were further randomly assigned to resistance training group and high-intensity interval. Duration of total training was 12 weeks. The result of this study shows that 12 weeks of HIIT and RT have similar effects reduced fasting glucose. (14)

(Church et al., 2010) conducted study to understand the Effects of Aerobic and Resistance Training on Hemoglobin A1c Levels in Patients with Type 2 Diabetes, for this purpose 262 sedentary men and women in Louisiana with type 2 diabetes and HbA1c levels of 6.5% or higher. They further randomly assigned to three different groups; resistant training (, n = 73), aerobic (n=72) and combined Resistant + Aerobic (n=76). The duration of training was nine months. The outcome of the study shows that combined group shows HbA1c level. (15)

(Da Silva et al., 2020) investigate the Effects of Concurrent Training Combining Both Resistance Exercise (RT) and High-Intensity Interval Training or Moderate-Intensity Continuous Training (MICT) on Metabolic Syndrome. For this study N=26 67.0 ± 6.7 years were included as volunteers, they further assigned to RT plus MICT (RT+MICT) (2 males; 11 females); RT plus HIIT (RT+HIIT) (4 males; 9 females) group. The duration of training were 12 weeks (3 days /week). Outcome of this study suggested that waist circumference improved in both groups, but not body weight, fat mass or fat-free mass, RT+HIIT shows improvement blood glucose, low density lipoprotein, insulin and homeostatic model assessment. while RT+MICT group reduced triglyceride. None of the group shows changes in high sensitivity C-reactive protein, glycated hemoglobin, high density lipoprotein and total cholesterol, systolic, diastolic or mean arterial blood pressure. (16)

OBJECTIVES OF STUDY

- To determine the effect of exercise on the metabolic health of females in different age group.

- To find out the influence of concurrent training insulin resistance, blood pressure, lipid profile, and blood glucose level.

- To find out the influence of concurrent training lipid profile.

- To find out the influence of Aerobic and Resistance Training on Body Composition (Fat percentage, muscle mass)

- To Understand the mechanisms of the effectiveness of exercise on human health.

CHAPTER- III

METHDOLOGY

In this chapter, the selection of subjects, selection of variables, experimental design, criterion measures, reliability of data, instrument reliability, tester's reliability, administration of tests, administration of training schedule, and statistical techniques employed for analysing the data have been described in this chapter.

SELECTION OF SUBJECTS

Those participants who fulfilled the inclusion criteria will include in the study. The age of the subjects would range from 25-35 years for experimental group -1, 36-45 for experimental group- 2, and a control group of age 25-45 years.

The experimental group will be instructed to perform a Concurrent training for 8 weeks and the control will continue the same daily routine they do not include in any training program.

The bellowed mentioned inclusion Criterion will be followed -

- Female subjects between the age range of 25-45 years.
- Sedentary untrained females according to the International Physical Activity Questionnaire (IPAQ)

Those who will be able to ful-fill the exercise preparticipation health screening process criterion will be selected as subjects.

Exclusion criteria.

- Females with cardiovascular diseases, diabetes, asthma, or any chronic diseases will be excluded from the study.
- Those not able to full-fill the criteria of the Physical Activity Readiness Questionnaire (PAR-Q 2020)

SELECTION OF VARIABLE

After investing in and reviewing the scientific literature the researcher selected the following variables for the study.

Dependent Variable

Insulin Resistance.

Fasting Insulin

Fasting Blood Glucose Level.

High- density Lipoprotein (HDL)

Low-Density Lipoprotein. (LDL)

Triglyceride

Total Cholesterol.

Systolic & Diastolic Blood Pressure.

Fat percentage.

Muscle Mass.

Independent Variable

Concurrent Training (Aerobic + Resistant Training)

ADMINISTRATION OF TESTS AND COLLECTION OF DATA

After selecting the subject, all the participants will randomly assign to the experimental and control group. The pre-test will be taken before the beginning of the intervention, and the post-test will take after the completion of 8 weeks of training intervention in case of experimental group. The post-training blood sampling will after recovery of 48 h from the last exercise session to avoid an acute effect of exercise.

To test the variable of metabolic biomarkers, all participants will be instructed to arrive at the laboratory with overnight fasting of a minimum of 8 h. The blood sample will be drawn to test the HDL-C, LDL-C, TG, Insulin resistance, fasting blood glucose, and fasting insulin.

The SBP and DBP, fat percentage, and muscle mass measurements will carry out according to the standard criteria. The insulin resistance levels will calculate by the formula of the homeostasis model assessment: HOMA-IR = (fasting glucose x fasting insulin/405).

The measurement of body composition (Fat percentage and Muscle Mass) will be measured with the help of digital bioelectric impedance (Maltron BIOSCAN).

RELIABILITY OF DATA

The reliability of data will be ensured by establishing the instrument reliability, the tester's competency, and subject reliability.

CONCURRENT TRAINING INTERVENTION

Concurrent training is the combination of Aerobic Training (AT) and resistance training (RT). The concurrent training will be given for a total duration of 8 weeks. The exercise will be given 5 days a week (Monday, Tuesday, Thursday, Friday, and Saturday).

The aerobic training will include, walking, running, and recreation of a range of 40-60 % of heart rate reserve. The load of exercise will be measured through the Karvonen method and the Borg rating of perceived exertion. Resistance training will include the free weight and body weight and elastic band exercises of 2-4 sets of 8 to 12 repetitions of exercise involving all major muscles. The training load will progressively increase week by week.

EXPERIMENTAL DESIGN-

Pre-test Post-test design

Group I- O X O

Group II- O X O

Concurrent - O O

(O- Observation, X – Concurrent Training)

STATISTICAL TECHNIQUE

To analyse the effect of concurrent training ANCOVA will apply, and to see determine the changes in each group, paired t-test will be applied. Also, effect size and change will be computed. The level of significance will be at 0.05 level.

Expected Outcomes of the Research

The result of this study may show the significant changes in metabolic biomarkers by following concurrent training.

BIBLIOGRAPHY

(1) Jorge MLMP, de Oliveira VN, Resende NM, Paraiso LF, Calixto A, Diniz ALD, Resende ES, Ropelle ER, Carvalheira JB, Espindola FS (2011) The effects of aerobic, resistance, and combined exercise on metabolic control, inflammatory markers, adipocytokines, and muscle insulin signaling in patients with type 2 diabetes mellitus. Metabolism 60(9):1244–1252

(2) Ehrman, J. K., Gordon, P. M., Visich, P. S., & Keteyian, S. J. (Eds.). (2013). *Clinical exercise physiology* (3. ed). Human Kinetics.

(3) *Metabolic Syndrome*. (n.d.). Retrieved May 5, 2023, from https://encyclopedia.pub/entry/2535

(4) Budoff M. Triglycerides and triglyceride-rich lipoproteins in the causal pathway of cardiovascular disease. The American Journal of Cardiology. 2017; 118: 138–145.

(5) Yi S, Park S, Lee Y, Park H, Balkau B, Yi J. Association between fasting glucose and all-cause mortality according to sex and age: a prospective cohort study. Scientific Reports. 2019; 7: 8194.

(6) Laaksonen DE, Lindström J, Lakka TA, Eriksson JG, Niskanen L, Wikström K, Aunola S, Keinänen Kiukaanniemi S, Laakso M, Valle TT (2005) Physical activity in the prevention of type 2 diabetes: the Finnish diabetes prevention study. Diabetes 54(1):158–165

(7) Ozderya A, Temizkan S, Aydin Tezcan K, Ozturk FY, Altuntas Y (2015) A case of Madelung's disease accompanied by Klinefelter's syndrome. Endocrinol Diabetes Metab Case Rep 2015:140119

(8) Hodson L, Karpe F (2019) Hyperinsulinemia: does it tip the balance toward intrahepatic fat accumulation? Endocr Connect 8(10): R157–R168. https://doi.org/10.1530/EC-19-0350

(9) Meex RCR, Blaak EE, van Loon LJC (2019) Lipotoxicity plays a key role in the development of both insulin resistance and muscle atrophy in patients with type 2 diabetes. Obes Rev 20(9):12051217. https://doi.org/10.1111/obr.12862

(10) Liu Y, Ye W, Chen Q, Zhang Y, Kuo C-H, Korivi M (2019) Resistance exercise intensity is correlated with attenuation of HbA1c and insulin in patients with type 2 diabetes: a systematic review and meta-analysis. Int J Environ Res Public Health 16(1):140

(11) AminiLari Z, Fararouei M, Amanat S, Sinaei E, Dianatinasab S, AminiLari M, Daneshi N, Dianatinasab M (2017) The effect of 12 weeks aerobic, resistance, and combined exercises on omentin-1 levels and insulin resistance among type 2 diabetic middle-aged women. Diabetes Metab J 41(3):205–212

(12) Monteiro PA, Antunes BMM, Silveira LS, Fernandes R, Freitas Jr I. [Effect of a concurrent training on risk factors for the accumulation of hepatic fat of obese adolescents]. Medicina (Ribeirão Preto). 2013;46(1):17-23.

(13) Connelly PW, Maguire GF, Lee M, Little JA (1990) Plasma lipoproteins in familial hepatic lipase deficiency. Arteriosclerosis 10(1):40–4

(14) Álvarez, C., Ramírez-Campillo, R., Ramírez-Vélez, R., & Izquierdo, M. (2017). Effects and prevalence of nonresponders after 12 weeks of high-intensity interval or resistance training in women with insulin resistance: A randomized trial. *Journal of Applied Physiology*, *122*(4), 985–996. https://doi.org/10.1152/japplphysiol.01037.2016

(15) Church, T. S., Blair, S. N., Cocreham, S., Johannsen, N., Johnson, W., Kramer, K., Mikus, C. R., Myers, V., Nauta, M., Rodarte, R. Q., Sparks, L., Thompson, A., & Earnest, C. P. (2010). Effects of aerobic and resistance training on hemoglobin A1c levels in patients with type 2 diabetes: A randomized controlled trial. *JAMA*, *304*(20), 2253–2262. https://doi.org/10.1001/jama.2010.1710

(16) Da Silva, M. A. R., Baptista, L. C., Neves, R. S., De França, E., Loureiro, H., Lira, F. S., Caperuto, E. C., Veríssimo, M. T., & Martins, R. A. (2020). The Effects of Concurrent Training Combining Both Resistance Exercise and High-Intensity Interval Training or Moderate-Intensity Continuous Training on Metabolic Syndrome. *Frontiers in Physiology*, *11*, 572. https://doi.org/10.3389/fphys.2020.00572